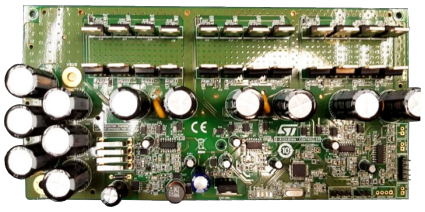
STDES-EVT001V1

Data brief

1 kW traction controller reference design for 3-phase BLDC motors for light electric vehicles



Features

- 48 V DC 1 kilowatt design
- Six Step drive commutation topology
- Input Voltage range: 42 V_{DC} to 65 V_{DC}
- Efficiency > 80%
- Compatible with any 5 V throttle
- Compatible with any start wound 48 V 3-phase BLDC motor with Hall sensor feedback
- Protections:
  - Overcurrent, overvoltage and undervoltage protection
  - Option for two levels of ovecurrent protection with different thresholds
  - Speed and position feedback fault detection and protection
- VIPER115LS based auxiliary power supply
- 3 LEDs for fault indication
- Drive ON/OFF switch
- Drive Forward/Reverse switch
- Drive disabled while mechanical brakes are applied
- RoHS compliant

Product summary	
1 kW traction controller for 3-phase BLDC motors	STDES-EVT001V1
STM8S motor control firmware library builder	STSW-STM8042
8-bit MCU with 32 Kbytes Flash, 16 MHz CPU, integrated EEPROM	STM8S105C6
ST Visual Develop IDE for ST7 and STM8 applications	STVD-STM8
N-ch 80 V, 8 mΩ typ., 100 A, STripFET F6 Power MOSFET in TO-220 package	STP100N8F6
high voltage high and low-side 4 A gate driver	L6491D
Applications	Small Electric Vehicles

Description

The 1 kW BLDC traction controller is a reference design for low voltage battery powered light electric vehicles running on nominal 48 V_{DC} and 50 A peak current. The wide input voltage range (42-65 V) and combination of hardware and design features deliver a highly responsive and efficient solution with fault diagnostic features that render this drive a highly viable solution across a variety of applications.

The inverter stage in full bridge 3-phase topology includes N-channel Power MOSFETs featuring STripFET F6 trench gate technology, driven by smart L6491 gate driver ICs with embedded comparators ensuringr real time cycle-by-cycle overcurrent protection.

The motor control logic is based on six step commutation in voltage mode, with Hall Sensor feedback for position detection. Detailed instructions are provided for configuring the firmware with an easy-to-use GUI and compiling the binary files for download onto the STM8S microcontroller.

The microcontroller section on the board can accommodate I²C and UART communication protocols for enhanced interfacing and control such as LCD display.

For further development, ST provides the ST Visual Development (STVD) environment and technical support for customizing and scaling the solution for Industrial and Automotive applications.

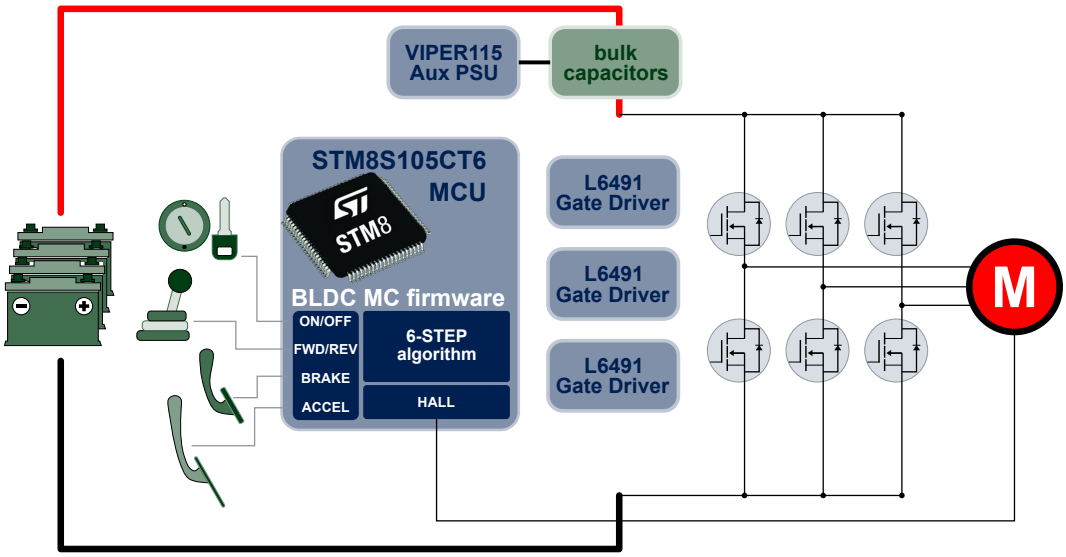
The system has been field tested on an e-Rickshaw, but it is designed for use with any low speed or light electric vehicles.

1 BLDC motor control for light electric vehicles

This BLDC motor control application is based on a 6-step motor control algorithm with motor position feedback information from magnetic field Hall sensors on the motor. The MCU firmware generates PWM signals for the gate drivers to control the power delivered to the 3 phases of the motor and therefore determine motor speed and rotation.

The design includes the necessary mechanisms for the normal inputs expected in a light electric vehicle, including on and off, forward and reverse, a throttle or accelerator, and a brake.

Figure 1. BLDC traction control for light electric vehicles



The protection mechanisms included to prevent excess heating and current are also crucial aspects of the design, and the safest and most responsive solutions use hardware elements to monitor thresholds and trigger immediate reactions when limits are exceeded, instead of relying exclusively on MCU responses, which may not intervene quickly enough to avoid damage or injury.

2 Schematic diagrams

Figure 2. STDES-EVT001V1 schematic diagram - MCU

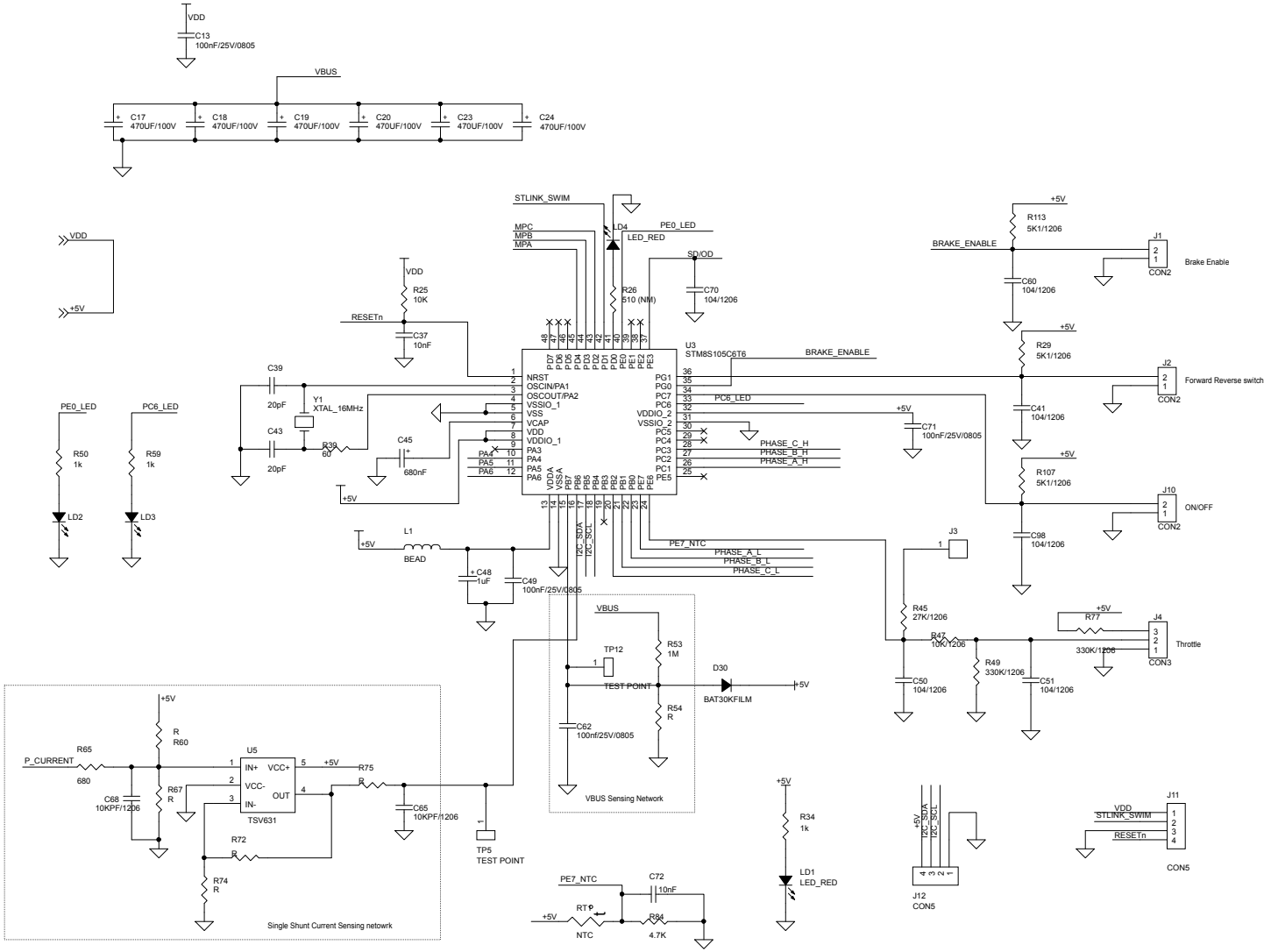


Figure 3. STDES-EVT001V1 schematic diagram - drivers

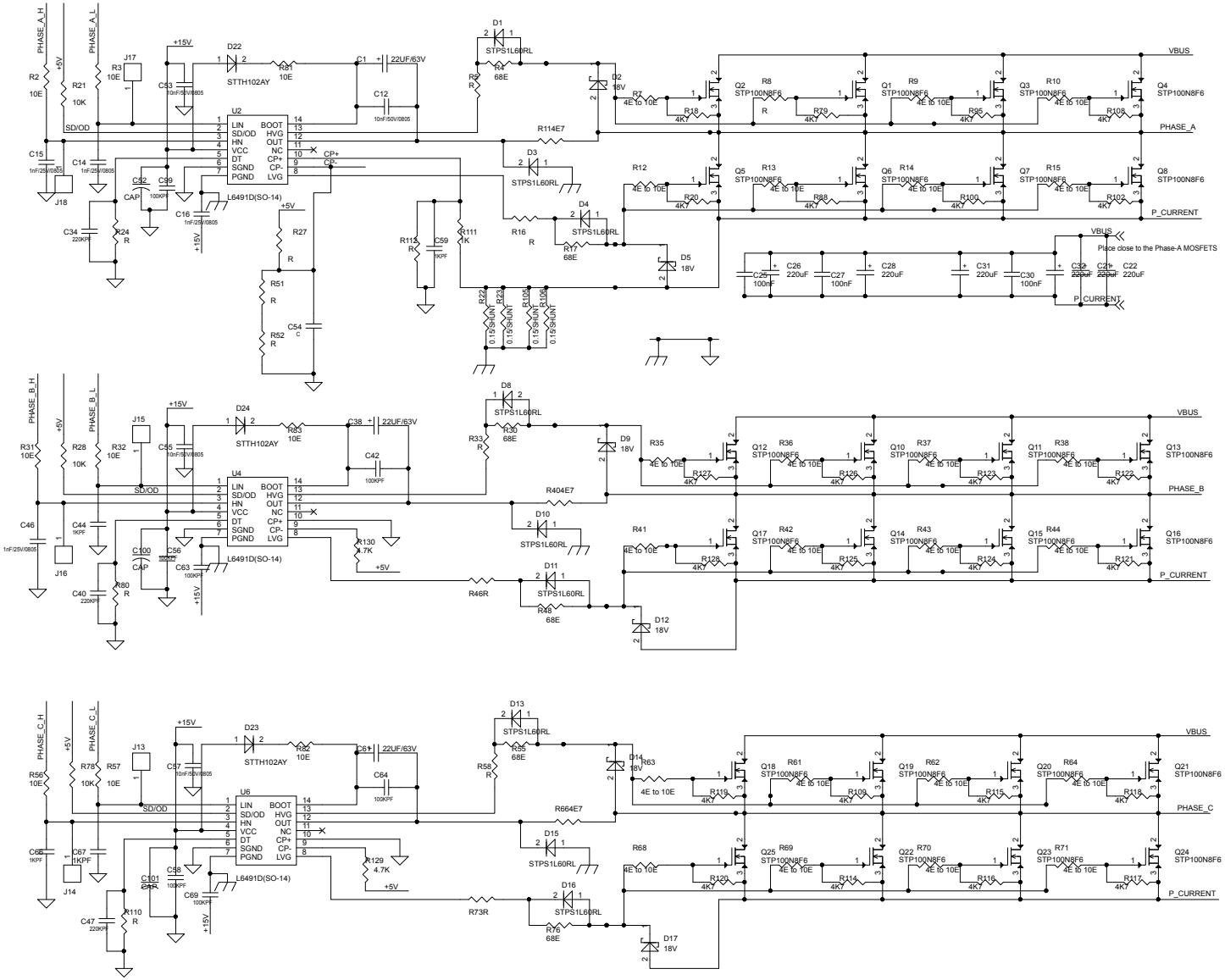
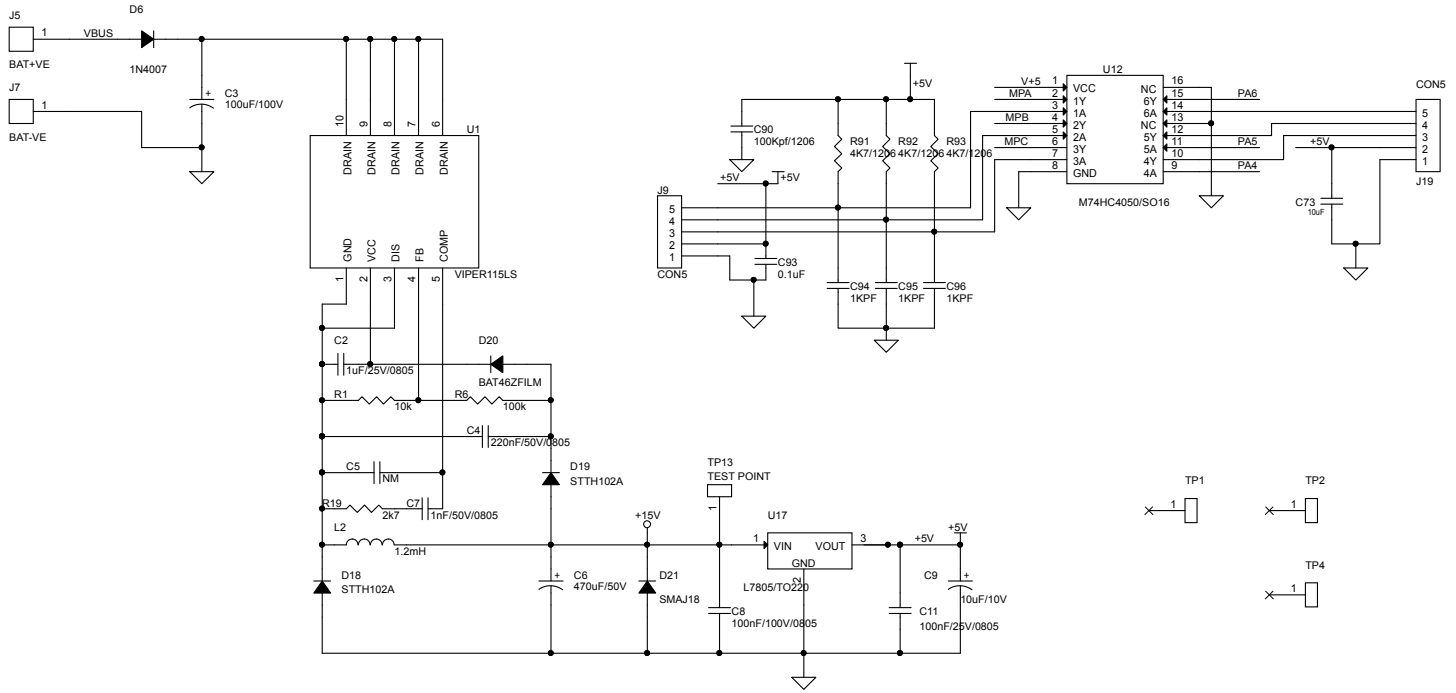


Figure 4. STDES-EVT001V1 schematic diagram - miscellaneous



Revision history

Table 1. **Document revision history**

Date	Version	Changes
04-Nov-2019	1	Initial release.

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